F (fluorine radicals) and ions corresponding to CF_2 are generated, each amount of said F and said ions is independent from each other, and

an etching treatment is performed in a condition, that said gas pressure in said etching treatment chamber is in the range from 0.1 Pa to 4 Pa.

REMARKS

CLAIM REJECTIONS UNDER 35 U.S.C. §102

Claims 1-18 and 21 were rejected under 35 U.S.C. §102(a) as being anticipated by Izawa et al JP 11-102894A for the reasons set forth on page 2 of the Office Action wherein the rejection is maintained as stated in paper No. 9 filed October 2, 2001.

For the reasons set forth hereafter, it is submitted that the claims, as amended, are patentable.

PATENTABILITY OF THE CLAIMS

By this amendment, all the independent claims, ie, 1, 8, 10, 17 and 18, have been amended to recite introducing CF group gas, Ar gas and one gas selected from O_2, SF_6, CF_4 and SiF_4 into the etching treatment chamber under a reduced pressure. The support for amendments is set forth in the

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specification at page 29, line 23 to page 30, line 3 and at page 41, lines 2-4.

The advantage of introducing the above gas into the etching treatment chamber is that it eliminates an accumulated film composed of carbon (c) prior to the etching process. During the dry etching process, a film of carbon accumulates on the surface of the wafer. Therefore a method for eliminating the accumulated C film comprising adding the above noted gases to the gas used for etching in connection with a film etching process performed using plasma having a first electronic temperature region and a second electronic temperature region.

The cited JP 11-102894A reference does not disclose introducing the specific gases set forth in the independent claims as amended. Thus, the components of gas used in the JP 11-102894A reference are as follows:

Example 1 (paragraph 0017): Ar, C_4F_8 and CH_2F_2
Example 2 (paragraph 0023): Ar, C_4F_8 and CH_2F_2
Example 3 (paragraph 0024): Ar, C_4F_8.

Claims 1-3, 5, 8, 10, 14, 16, 17 and 18 are therefore submitted to be patentable over the cited JP reference.

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NIP-154

In view of the foregoing amendments and remarks, Applicants contend that this application is in condition for allowance. Accordingly, reconsideration and reexamination are respectfully requested.

Respectfully submitted,

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NIP-154

MARKED UP VERSION OF REWRITTEN CLAIMS

1. (Twice Amended) A dry etching method comprising the steps of,

preparing a semiconductor wafer which comprises a semiconductor body, a plurality of gate electrodes formed on a main surface of said semiconductor body, a nitride film formed to cover said gate electrodes on said main surface, an oxide film formed to cover said nitride film on said main surface, and a mask film having a hole pattern formed on said oxide film, said hole pattern exposing a surface portion of said oxide film located between said gate electrodes;

disposing said wafer in an etching treatment chamber;

introducing CF group gas, Ar gas and one gas selected from O_2, SF_6, CF_4 and SiF_4 into said etching treatment chamber under a reduced pressure;

generating electromagnetic waves and a magnetic field in an etching treatment chamber under vacuum,

generating plasma by electron-cyclotron resonance, and

etching said surface portion of said oxide film in said hole pattern in said etching treatment chamber, wherein

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a distance between an antenna which is arranged in said etching treatment chamber and injects the electromagnetic waves, and said wafer is set at a value in the range from 30 mm to 100 mm,

the frequency of said electromagnetic waves is set at a value in the range from 300 MHz to 600 MHz,

a magnetic field gradient is set,

two kinds of electronic temperature regions are generated between said antenna and the wafer, and

an etching treatment is performed in a condition, that a gas pressure in said etching treatment chamber is in the range from 0.1 Pa to 4 Pa.

2. (Twice Amended) A dry etching method as claimed in claim 1, further comprising the steps of:

[introducing a gas consisting of at least carbon and fluorine into said etching treatment chamber,]

generating F (fluorine radicals) and ions corresponding to CF_2 in said plasma, each amount of which is independent from each other, and

performing said etching treatment.

3. (Twice Amended) A dry etching method as claimed in claim 2, further comprising the steps of:

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[introducing a gas consisting of at least carbon and fluorine into said etching treatment chamber,]

determining power of a high frequency power source for generating said high electromagnetic waves, and

performing said etching treatment.

5. (Twice Amended) A dry etching method as claimed in claim 1, further comprising the steps of:

[introducing a gas consisting of at least carbon and fluorine into said etching treatment chamber,]

generating electromagnetic waves and a magnetic field in said etching treatment chamber,

generating plasma by electron-cyclotron resonance (ECR),

determining a position of ECR,

generating F (fluorine radicals) and ions corresponding to CF_2 in said plasma, each amount of said F and said ions being independent from each other, and

performing said etching treatment.

8. (Twice Amended) A dry etching method comprising the steps of:

preparing a wafer which comprises a substrate, a plurality of gate electrodes formed on a main surface of said

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substrate, a first film containing nitrogen formed to cover said gate electrodes on said main surface, a second film containing oxygen formed to cover said first film on said main surface, and a mask film having a hole pattern formed on said second film, said hole pattern exposing a surface portion of said second film located between said gate electrodes;

disposing said wafer in an etching treatment chamber;

introducing [a gas consisting of at least carbon and fluorine] CF group gas, Ar gas, and one gas selected from O_2, SF_6, CF_4 and SiF_4 into said etching treatment chamber under a reduced pressure,

generating electromagnetic waves and a magnetic field in said etching treatment chamber,

generating plasma by electron-cyclotron resonance, and

performing an etching treatment with said wafer, wherein

a distance between an antenna, which is arranged in said etching treatment chamber and injects the electromagnetic waves, and said wafer is set at a value in the range from 30 mm to 100 mm,

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a magnetic field gradient is controlled by setting the frequency of said electromagnetic waves at a value in the range from 300 MHz to 600 MHz,

a generation ratio of CF_2/F is controlled by varying two kinds of electronic temperature regions between said antenna and said wafer, and

an etching treatment for selectively etching said second film is performed.

10. (Twice Amended) A dry etching method comprising the steps of:

preparing a wafer which comprises a substrate, a plurality of gate electrodes formed on a main surface of said substrate, a first film containing nitrogen formed to cover said gate electrodes on said main surface, a second film containing oxygen formed to cover said first film on said main surface, and a mask film having a hole pattern formed on said second film, said hole pattern exposing a surface portion of said second film located between said gate electrodes;

disposing said wafer in an etching treatment chamber;

introducing [a gas consisting of carbon and fluorine] <u>CF group gas, Ar gas, and one gas selected from O_2,</u>

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SF_6, CF_4 and SiF_4 into said etching treatment chamber under vacuum,

generating electromagnetic waves and a magnetic field in said etching treatment chamber,

generating plasma by electron-cyclotron resonance, and

performing an etching treatment with said wafer, wherein

a distance between a wafer facing plane, which is arranged in said etching treatment chamber, and said wafer is set at a value in the range from 30 mm to 100 mm,

a magnetic field gradient is determined by setting the frequency of said electromagnetic waves at a value in the range from 300 MHz to 600 MHz,

two kinds of electronic temperature regions are generated between said wafer facing plane and said wafer, and

an etching treatment is performed in a condition, that a gas pressure in said etching treatment chamber is in the range from 0.0 Pa to 4 Pa.

14. (Twice Amended) A dry etching method as claimed in claim 13, wherein

[a gas consisting of at least carbon and fluorine is introduced into said etching treatment chamber,]

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two kinds of electronic temperature regions are generated between said wafer facing plane and said wafer,

F (radicals) and ions corresponding to CF_2 in plasma are generated, each amount of said radicals and said ions is independent from each other, and

said etching treatment is performed.

16. (Twice Amended) A dry etching method as claimed in claim 14, wherein

F (fluorine radicals) and ions corresponding to CF_2 in said plasma are generated, each amount of said F and said ions is independent from each other, in correspondence to an etching process of the oxide film, and

[Said] said etching treatment is performed.

17. (Twice Amended) A dry etching method comprising the steps of:

preparing a semiconductor wafer which comprises a semiconductor body, a plurality of gate electrodes formed on a main surface of said semiconductor body, a nitride film formed to cover said gate electrodes on said main surface, an oxide film formed to cover said nitride film on said main surface, and a mask film having a hole pattern formed on said oxide

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film, said hole pattern exposing a surface portion of said oxide film located between said gate electrodes;

disposing said wafer in an etching treatment chamber;

introducing CF group gas, Ar gas and one gas selected from O_2, SF_6, CF_4 and SiF_4 into said etching treatment chamber under a reduced pressure;

generating electromagnetic waves and magnetic filed in said etching treatment chamber,

generating plasma by electron-cyclotron resonance in said etching treatment chamber, and

performing an etching treatment with said wafer, wherein

a distance between a wafer facing plane, which is arranged in said etching treatment chamber, and said wafer is set at a value in the range from 30 mm to 100 mm,

a magnetic field gradient is determined by setting the frequency of said electromagnetic waves at a value in the range from 300 MHz to 600 MHz,

the generation ratio of CF_2/F is controlled by making two kinds of electronic temperature regions, which are generated between said wafer facing plane and said wafer, variable by controlling the magnetic field gradient, and

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the etching treatment for selectively etching said nitride film is performed.

18. (Twice Amended) A dry etching method comprising the steps of:

preparing a wafer which comprises a substrate, a plurality of gate electrodes formed on a main surface of said substrate, a first film containing nitrogen formed to cover said gate electrodes on said main surface, a second film containing oxygen formed to cover said first film on said main surface, and a mask film having a hole pattern formed on said second film, said hole pattern exposing a surface portion of said second film located between said gate electrodes;

disposing said wafer in an etching treatment chamber;

introducing [a gas consisting of at least carbon and fluorine] CF group gas, Ar gas, and one gas selected from O_2, SF_6, CF_4 and SiF_4 into said etching treatment chamber so as to maintain a gas pressure in said etching treatment chamber,

generating plasma by electron-cyclotron resonance in said etching treatment chamber, and

performing an etching treatment with a wafer, wherein

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a distance between a wafer facing plane, which is arranged in said etching treatment chamber, and said wafer is set at a value in the range from 30 mm to 100 mm,

each of frequencies of a high frequency power source for generating first electromagnetic waves and a high frequency power source for generating second electromagnetic waves is set at a value in the range from 300 MHz to 600 MHz, respectively,

high frequency bias having a lower frequency either of the first electromagnetic waves and the second electromagnetic waves is applied to a process platform,

the wafer is treated thereon,

two kinds of electronic temperature regions are generated between said wafer facing plane and said wafer,

F (fluorine radicals) and ions corresponding to CF_2 are generated, each amount of said F and said ions is independent from each other, and

an etching treatment is performed in a condition, that said gas pressure in said etching treatment chamber is in the range from 0.1 Pa to 4 Pa.

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